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ABSTRACT

This report describes Project HOT, which is designed to create knowledge about teaching higher order thinking skills across ability levels of African-American students enrolled in urban schools. The report states that three activities are central to the overall purpose of the program: (1) training students to think critically and creatively; (2) designing a model of strategic thinking; and (3) publishing and sharing knowledge gained. Sections of the report describe the program's goals, activities, budget, organizational profile, consultants, outcomes, and present a strategic teaching model. A position paper ("Knowledge as design: Learning for the 21st Century") is attached, as well as a 21-item bibliography. (RS)

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"The truly wise individual is one who understands that there may be something important to be learned from any other human being."

David Bohm and F. David Peat
*Science, Order, and Creativity*

# PROJECT HOT

**a comprehensive program for the development of higher order thinking skills in urban middle school students (D. N. Perkins' knowledge as design for reasoning, writing, reading skills; M. Asante's Afrocentricity; M. J. Adler's Junior Great Books; and 21st century studies for content)**

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J. P. Harris, Principal
Sulzberger M. S.

***THINK LEARN CREATE***

CS009750

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## EXECUTIVE SUMMARY

> The mission of Project HOT is to create knowledge about teaching higher order thinking skills across ability levels of African American students enrolled in urban schools.

Three activities carry out this central purpose.

- training students to think critically and creatively
- designing a model of strategic thinking
- publishing and sharing knowledge gained

All of Project HOT's goals, activities, timelines, formal evaluations, budgetary items, organizational structure, selection of consultants, and outcomes derive from its mission.

A few basic arguments serve as rationales for this new research and development program.

1. There is a national need for a more comprehensive model of teaching higher order thinking skills across ability levels of minority students.

2. There is a national need to make educational research more practice sensitive.

3. There is a global need to design research and development programs that will address complex issues within the framework of the holographic paradigm--an emerging twenty-first century world view.

These arguments form the context of Project HOT's mission and goals.

GOALS

To carry out its mission, Project HOT will meet the following goals by 1993.

1. Train students in D. N. Perkins' knowledge as design method of critical and creative thinking.
2. Give students extensive practice in twenty-first century basic skills, i.e. thinking, learning, and creating via development of an Afrocentric perspective, a paidia program (Jr. Great Books) and 21st century studies.
3. Conduct a pilot study by 1993.
4. Publish documents in the ERIC data base (RIE).

The first goal is rooted in the research base for higher order thinking. (Resnick, 1987) cites the need to combine the insights of cognitive science and epistemology in a single method. She also says higher order thinking skills should be taught in a content area, across the curriculum and as a separate subject.

**Knowledge ad design,** D. N. Perkins' method of critical and creative thinking, puts the best of what we know about how people learn into a single, dialectical system that is taught in any content area, in the enabling skills across the curriculum, and as a metacognitive strategy for comprehending texts, tools, or claims--any structure adapted to a purpose. (Perkins, 1986)

In addition, Mortimer J. Adler's paidia program, which grew out of his work at University of Chicago in the 1940s and has since become a full grown approach to teaching dialectical thinking from first grade to Ph.D., offers an approach for helping students to develop an understanding of ideas and issues through reading and discussing great books. (Alder, 1988)

Better known as a **Great Books** approach, Adler's paidia program provides content while Perkins' method provides a framework for skill development. Together the approaches provide a comprehensive method for giving children extensive practice in what John Naisbitt called the new basics--thinking, learning, and creating. (Naisbitt, 1986) The two approaches are Yin and Yang.

Finally, teacher wisdom and extensive research already connect self esteem and cognitive performance. Thus using Molei Asante's **Afrocentricity** to increase self esteem of African American students participating in the training makes plain old fashioned good sense.

Less is known about the relationship between imaging the future and cognitive performance, but 21st century studies does provide another content area for teaching the knowledge as design method. 21st Century Studies is a topical area that futurist across the planet are developing. At Futureview: 1990s and beyond, the 6th General Assembly of the World Future Society, 21st century studies aims to examine particular nations for long terms trends characterizing their development. But the term has another use--a broad heading for a range of themes. In the pilot training of this program, NASA's strategic vision for colonizing space will be the focus of study. Thus **space colonization** is the theme for training in this interdisciplinary content area.

Goal three synthesizes and evaluates the outcomes of training, and goal four shares the knowledge gained with other learners.

I see and I forget. I hear and I remember.
I do and I understand. Chinese Proverb

ACTIVITIES

Project HOT will do the following.

•Teach 100 middle school students a year to use D. N. Perkins' knowledge as design for reasoning, writing, reading in two theme centered projects and M. J. Adler's paidia program (Jr. Great Books) as taught in a Reading/English course at Sulzberger Middle School in Philadelphia, PA.
•Review literature.

file 1: works by and about D. N. Perkins
file 2: state-of-the-art in teaching higher order thinking
file 3: state-of-the-art in creativity research
file 4: examples of the emerging 21st century world view

•Answer these questions:

1. Can children be taught to think dialectically?
2. What are the critical variables in a model of strategic teaching?
3. Does training in knowledge as design increase scores on measures of cognitive performance? (This is the research problem for the pilot study.)

•Publish in RIE.

All four activities seek to develop insights about the relationships between the treatment variable, knowledge as design, and the trait variable, cognitive performance. Knowledge as design is a variable with six levels: reasoning, writing, reading, Afrocentricity, Jr. Great Books, and Space colonization. Cognitive performance is a variable with repeated measures on a city wide achievement test and any other valid measures of knowledge and skills.

"Education is the process whereby the powers of human nature become developed by good habits."

Mortimer J. Adler
*Reforming Education: The Opening of the American Mind*

In summary, Project HOT will use D. N. Perkins' knowledge as design to teach higher order processes in the enabling skills (reasoning, writing, reading, creative problem solving) as a framework for two theme centered projects (Afrocentricity and 21st century studies) and as an instructional method for a content area (Jr. Great Books). It will be taught within the context of a Reading/English curriculum.

For examples, consider the following.

•The Afrocentricity project centers on using knowledge as design to guide Directed Reading and Thinking Activities. (DRTA). *The aim of the unit is to increase student knowledge about African American thinkers and performers and, thus, increase self esteem.* The unit begins in the second short period and peaks during Black History month. Student biographies on Great African Americans--past, present or future--document the activity. Each report presents its purpose, a description of the person selected, a discussion of how that person achieved greatness, model cases of others achieving greatness in similar fields, and an argument about the degree to which the person will be considered great in the future. The project includes field trips, speakers and performances to build an Afrocentric perspective among students. This unit is part of a larger project on the theme **Return to Roots**.

Note.
Return to Roots is a PATHS/PRISM collaborative grant that a team of educators in Sulzberger middle school is implementing 1989-1990. Kathleen Osorio and Runa Chatterjee are Co-Directors of the project

•Paidia program centers on creating three reports (one written, two oral) on Jr. Great Books. It includes at least one of Shakespeare's plays per grade level. *The unit aims to teach students to think about ideas and issues, as well as truth and errors in great books.* A dialectical exploration, this is a whole term unit that incorporates knowledge as design into DRTA's on all books read. While students have formal evaluations on just three of the books, they will be encouraged to read at least one great book per month. Also weekly practice with knowledge as design may include selections from one great book of nonfiction--the 81 passages of the *Tao Te Ching* or Gibran's *The Prophet*.

•The 21st Century studies projects *aims to increase the students ability to imagine the future*. In the pilot year, this project centers on NASA's strategic vision to colonize space by 2050 A.D. This project begins with DRTA's on The first moon walk. Then it continues with DRTA's on future cities and space colonies. Finally, it ends with a creative problem solving format leading to model of a space colonies.

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TIMELINES AND FORMAL EVALUATIONS

The Instructional time for the 10 month, pilot training is organized into thirds, one for each report card period, and centers on three areas. In sum, the time is divided between instruction in knowledge as design in three areas: Afrocentricity, the Paidia program, and 21st century studies.

**Instructional timelines - Table One**

| | Three Report Card Periods | | |
|---|---|---|---|
| Areas | 1 | 2 | 3 |
| Afrocentricity | library skills | biography | creative project |
| Paidia | Jr. Great Books including Shakespeare | | |
| 21st Century Studies | moonwalk project | space colony project | creative project |
| Personalized Instruction | weekly conferences with student authors and thinkers | | |

Using knowledge as design (KAD) as a framework for instruction, basic skills are taught weekly. This is a top down approach for acquiring basic language competencies in reading, writing, and reasoning.

Measurement of skill acquisition is both informal and formal.

Using active instructional techniques, every child responds to questions. And every child has chances to create knowledge each class period. That means informal observations about individual and class progress occur daily. The informal evaluation includes weekly conferences as a personalized system of instruction.

Finally, such feedback measures lead to a participation rating of excellent, good, adequate, and inadequate--4, 3, 2, 1. Ratings are then converted to a quantitative scale (4 = 100, 3 = 90, 2 = 80, 1 = 70). The participation factor is then added to scores from formal evaluations.

Formal evaluations are based on major projects, tests or writing assignments and are placed strategically to sum individual progress each report card period. The chart below highlights the scheduled formal evaluations for the pilot training session.

**Formal work products and evaluations - Table Two**

| | Three Report Card Periods | | |
|---|---|---|---|
| **Areas** | **1** | **2** | **3** |
| Afrocentricity | library skills<br>oral test | biography | creative<br>project |
| Paidia program | written<br>report<br>evaluated | oral<br>report<br>evaluated | oral<br>report<br>evaluated |
| 21st Century Studies | moonwalk<br>essay or<br>story | space colony<br>essay or<br>story | CPSF<br>creative<br>project |

**Note.**

**All written works are evaluated with a holistic scale for reader based prose. The scale reflects the generic features of knowledge as design and the principles of effective writing described in E. B. White's *Elements of Style.***

In each report card period, then, four factors generate grades:

- •participation rating
- •Afrocentricity work products
- •Paidia Program work products
- •21st Century Studies work products

Each factor converts to a quantitative scale to compute mean scores. Thus in the first report card period the sum of four scores divided by 4 yields the formal evaluation for the student. For example, a child rates 4 in participation, 4 in the library essay test, 4 in the jr. Great Books written book report, and 4 in the moonwalk essay story. The ordinal scores of this holistic scale convert to an interval scale so that mean scores of base 100 can be computed. The sum of scores for this sample child is 400. When divided by N--the four factors--the child earns a mean score of 100. Such a score would be a grade of A according to a 100-91, interval = 9, scale. (See table three.)

**Formal evaluation scales - Table Three**

---

Three Report Card Periods

| Factors | 1 | 2 | 3 |
|---|---|---|---|
| Participation<br>Afrocentricity<br>Paidia program<br>21st century studies | ordinal rating converted to interval scale | ordinal rating converted to interval scale | ordinal rating converted to interval scale |
| formal evaluations | mean = Sum of scores/4 factors | mean = Sum of scores/8 factors | mean = Sum of scores/12 factors |
| holistic scale | 4 = excellent<br>3 = good<br>2 = adequate<br>1 = inadequate | | |
| interval scale | 100-91 = A<br>90-81 = B<br>80-71 = C<br>70-61 = D<br><60 = F | | |

note.
Given the high expectations built into this training, grades should be close to a normal curve for each report card period. But training in KAD might have a two sigma effect. If so, scores on standard measures of cognitive performance might be two standard deviations higher than previous measures.

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BUDGET pilot training year only (Reading/English)

materials

books:

| | | |
|---|---|---|
| two novels and one Shakespearian play (set of 30 each x $10.00) | | $1,200.00 |
| library of jr. Great Books | | $1,800.00 |
| | Sub Total | $3,000.00 |

subscriptions:

| | | |
|---|---|---|
| *New York Times* and *Philadelphia Inquirer* | | $ 150.00 |
| | Sub Total | $ 150.00 |

video tapes:

| | | |
|---|---|---|
| rentals (e.g. *Roots, Romeo and Juliet*) | | $ 50.00 |
| | Sub Total | $ 50.00 |

**games for critical and creative thinking**

**software**

| | |
|---|---|
| space colony | $ 50.00 |
| Shogun | $ 50.00 |
| Kobyashi scenario | $ 50.00 |
| Sargon Chess | $ 50.00 |
| Sub Total | $ 200.00 |

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**board games**

| | | | |
|---|---|---|---|
| Star Hop | | | $ 25.00 |
| World Futures | (set of 5 x $2.00) | | $ 10.00 |
| chess sets | (15 sets x $10.00) | | |
| | | | $ 150.00 |
| Go | (two sets x $25.00) | | $ 50.00 |
| Quadular (four way chess) | (two sets x $20.00) | | $ 40.00 |
| | | Sub Total | $ 275.00 |

**Administrative costs** (i.e. duplication, rental of laster printers, field trips to Franklin Institute Futures Center, Blockson collection, Freedom Theater, publication of student anthology of writing or newsletter)

$5,000

**Equipment**

Macintosh Desk top publication system,
vcr and television

$7,000

**Supplies and furniture** $2,325

**Consultant fees** $2,000

**Staff Development and travel** $5,000
training collaborators to use
knowledge as design and Jr. Great Books

**Total =** **$25,000**

ORGANIZATIONAL PROFILE

Project HOT will be a **network** of the following members:

**Director** (responsible for research and development program and the overall project)

**Collaborators** (responsible for specific duties of the research and development program)

**Consultants** (responsible for technical assistance on the selection of research methodologies, training strategies, and organizational development)

**VITA**

**Jerry E. Fluellen** is the Founder and Director of Project HOT.

With 15 years experience as an educator, he has been a Teacher Corps Intern, English and Elementary Education Teacher in the Philadelphia School System, a merit raise winning Instructor of Composition at Temple University and a Project Coordinator in Temple University's Center for Research in Human Development and Education.

He has studied at Bard College's Institute for Thinking and Writing, Cheney University, University of Pennsylvania, and University of New Hampshire. His undergraduate and graduate degrees are from Temple U. where he is presently a doctoral student concentrating in cognitive processes.

In addition to his professional training in education, Jerry has studied Journalism in Temple University's Graduate School of Communication and worked as an Issue Statement writer for Human Resource Network. He also studied acting at Freedom Theater and participated in "Futureview: 1990s and beyond," the World Future Society's Sixth General Assembly at the Sheraton Washington, July 16-20, 1989.

A father of three children, Jerry serves as Sub Deacon, member of the Long range planning committee, and Chaplin of the Choir at St. Luke's Episcopal Church, Germantown. He is Vice President of the Union of Black Episcopalians, Philadelphia Chapter, a member of the executive committee, and former editor of the chapter's newsletter, *Linkage*. Finally, he holds memberships in the International Meditation Society, Kappa Alpha Psi Fraternity, and a professional membership in the World Future Society.

**CONSULTANTS** (UNCONFIRMED)

The consultants below represent a cross section of disciplines. The aim is to establish an interdisciplinary network of professionals who can provide fruitful dialogue about development of higher order thinking in African American students.

Thomas Anderson, Director of Community Relations, Temple U.
Sarah Banks, Director of Admissions, Temple U.
Helmut Bartel, Professor of Educational Psychology, Temple U.
Charles Blockson, Curator
Helen Carp, Librarian, Sulzberger M. S.
Daisy Century, Science Coordinator, Sulzberger M. S.
John Chen, Special Assistant to the Dean, Temple U. College of Ed.
Roni Collins, District Four Reading Administrator
John Cooper, Composer, Educator
Runa Chatterjee, Reading Resource Specialist, Sulzberger M. S.
Ricardo Curry, House Director Sulzberger M. S.
Epifanio De Jesus, Director of Community Relations Medical campus, T. U.
Beryl Evans, Head Librarian, Philadelphia Free Library
Otto Evans, Systems Analyst, Philadelphia Public Schools
Marjorie Farmer, Priest, St. Matthias Episcopal Church
Jerry Fluellen, III, Temple University Senior
Sharon Haynee, Scientist, Dupont
Christine Hite, Mathematics Teacher, Lincoln H. S.
David Horowitz, Professor, Temple University
Raymond Kane, Roster Chair and Mathematics Instructor, Sulzberger M. S.
Ann Merrick, House Director Sulzberger M. S.
Rose McNeil, House Director Sulzberger M. S.
Carol Muldrow, Attorney at Law
Clinis Noble, Language Arts Teacher, Sulzberger M. S.
Kathleen Osorio, Reading Resource Teacher, Sulzberger M. S.
David Perkins, Director, Project Zero, Harvard University
Ernestine Rouse, Vice-president of the Philadelphia School Board
P. Sanahan, Coordinator, Sulzberger M. S.
Joann Shafer, House Director, Sulzberger M. S.
Thomas Snowden, African American History scholar and writer
Arthur Stevens, Resource Teacher, Sulzberger M. S.
Clara Tolbert, Board of Directors, PATHS/PRISM
Fasaha Traylor, Program Officer, William Penn Foundation
Rosemary Vallentine, District Six Reading Administrator
Margaret Wang, Professional of Educational Psychology, Temple U.
Bernard Watson, President of William Penn Foundation

**OUTCOMES**

Three outcomes will result from the work of Project HOT.

1. Each successful student will have practices the 21st century basic skills: thinking, learning, creating. That means they will know how to think critically and creatively; they will use knowledge as design to organize and store information in long term memory; they will be able to create knowledge from multiple sources of information.
2. From the perspective of cognitive performance, mean scores on standard tests of reading comprehension will be significantly higher after 10 months of training.
3. From the perspective of furthering knowledge, a model of strategic teaching will be developed. This model will have practical value for Sulzberger Middle School in Philadelphia. Its school improvement plan aims at reading comprehension. A model of strategic teaching that relates a key treatment variable (knowledge as design) a key trait variable (cognitive performance) should facilitate development of the school improvement plan. The model of strategic teaching will have theoretical value to the degree that it succeeds in describing one way African American Middle school students can be taught higher order thinking skills across ability levels.

One major spin off of the training will be a pilot study of this problem: Does knowledge as design increase, significantly, the cognitive performance of African American middle school students? This problem has two variables, each with multiple levels.

**Key variables for pilot study - Table Four**

| **treatment variable = knowledge as design** | **trait variable = cognitive performance** |
|---|---|
| enabling skills | level one: city tests, repeated measures |
| level one: reasoning<br>level two: writing<br>level three: reading | level two: reading tests, repeated measures<br>level three: other standard test of cognitive performance |
| content | |
| level four: Afrocentricity project<br>level five: Jr. Great Books project<br>level six: space colonization project | |

"I shall be telling this with a sigh
Somewhere ages and ages hence:
Two roads diverged in a wood, and I--
I took the one less traveled by,
And that has made all the difference."

Robert Frost
"The Road Not Taken"

**STRATEGIC TEACHING: A Model**

Strategic teaching means using explicit systems of instruction that change the cognitive structures of all members of the learning group. The chief outcome of Project HOT may just turn out to be a model of how teaching higher order thinking can be done in a way that does change teachers and students alike.

The present conceptual model of strategic teaching can be expressed as a simple formula:

**S = H (kM)**

Let

S = strategic teaching

H = holographic paradigm of 21st century world view, a constant (1.0)

k = knowledge as design (treatment variable with several levels, e.g., reading, writing, reasoning, Afrocentricity, Paidia program, and 21st Century studies)

M = sum of methods, materials, measurements, and management of classroom system, the variables M1, M2, M3, M4

Implicit in the model are these assumptions:

- use of the holographic paradigm for selection of systems
- use of dialectical systems that might change the cognitive structures of all members of the learning system (e.g. Knowledge as design is a dialectical system.)
- use of dialectical operations as a system goal to direct change efforts

These assumptions dictate choosing knowledge as design over all the other very good programs for critical thinking. They also guide selection of Afrocentricity, Paidia, and Space colonization as content areas that encourage dialectical thinking.

Note.

1. Using the appropriate world view, namely Karl Pribram and David Bohm's **holographic paradigm**, means the strategic teaching model takes values and beliefs from an emerging post industrial age world view that favors holistic and dialectical approaches. It governs the selection of other systems in the equation as well. For example, David Perkin's knowledge as design is both a holistic approach to higher order thinking and a dialectical one, joining critical and creative thinking into a single system. Furthermore, it combines insights gained from research in cognitive science and epistemology.

2. D. N. Perkins, Harvard University, invented **knowledge as design** to teach critical and creative thinking across ability levels, races, and age groups. It seems to be the most simple system for teaching higher order thinking. And it is as James Thurber once wrote in "Good Women of Orion."

"Simplest things last longest. The microbe outlived the mastodon."

Perkins says any "structure adapted to a purpose" has four generic, design features: purpose, structure, model cases and arguments. These four items yield a framework for both comprehending and creating texts.

Thus teachers can use knowledge as design to write tests, games, worksheets, and Directed Reading and Thinking Activities, etc. Students can use the model to improve reading comprehension or write in any subject. Teachers and students, in short, can become active creators of knowledge. Knowledge as design affects all members of the learning system.

3. Michael Basseches, Clark University, invented the construct **dialectical thinking**. From a neo Piagetian, life span view of cognitive development, dialectical thinking is a meta systemic level beyond formal operations and seems to be the only definition of higher order thinking that has been operationalized to date. It also extends Piagetian theory and provides an optimal goal for instruction. Dialectical thinking combines the logical deductive reasoning power of formal operations with creative insight power.

Future research may describe links between dialectical operations and creative intelligence--the theoretical source of pure knowledge. Already the holographic paradigm connects the hologram called brain and the holographic universe, the mathematics of perception to the manifestations of consciousness; it joins analytical and holistic thinking, intellect and intuition, Eastern mysticism to Western science. It joins yin and yang.

4. Building on the works of Watzlawick in psychology and Bohm in physics, change in cognitive structure, as sought with the knowledge as design method, might be of three orders:

- first order, a change in concepts while the cognitive structure remains the same
- second order, a transformation of the cognitive structure
- third order, generation of a new cognitive structure

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Using Piagetian theory as a model to describe these orders of change, sensori motor, pre-operational, concrete operational, and formal operational represent cognitive stages of development. Each stage is a cognitive system. Each has a set of concepts that forms the knowledge base. New concepts may be added without a change in system. But when knowledge acquisition forms a critical mass of concepts, a person's cognitive stage (system) is transformed to the next stage. When this happens, second order change occurs.

The leap from formal operational to dialectical operational, however, as Basseches describes it in his body of work, is so great that a meta systemic level occurs--dialectical thinking is dramatically different from the other stages. Very bright people may stay at formal operational the rest of their lives while other equally bright people generate a whole new way of thinking that is at once critical and creative. To account for the difference between Piaget's final system, formal operations, and Basseches' meta system, dialectical operations, David Bohm's generative order can be used. In this sense a whole new system is created. The generative order is most graphically seen from the vantage point of evolution as described in Peter Russell's *The Global Brain*. For Russell, each key period in evolution is so unlike its source that something seems to have been created from nothing. The universe began as nothing. Then there was light--the cosmic egg. Eons later matter formed from the energy dispersed from the cosmic egg's big bang. From matter cane one celled life forms. Then multicellular plants and animals. And so on up to human beings or, perhaps, computers. Each new development was dramatically different from what was before. Thus each became more than just a transformation of the system. Each became more than what Joseph Chilton Pearce called a metanoia or fundamental transformation of mind. What marks the key evolutionary events is its generative characteristic.

The leap from formal operations to dialectical operations is generative.

5. Project HOT's attention to what David Bohm calls "free dialogue" with people across disciplines (the collaborators and consultants) will change the model dramatically during the 1990's. By year 2000, the model--S = H (kM)--should be very different.

6. Finally, Marilyn Ferguson's words gives the gist of Project HOT's historical context.

> "In a nutshell, the holographic supertheory says that our brains mathematically construct 'concrete' reality by interpreting frequencies from another dimension, a realm of meaningful, patterned reality that transcends time and space. The brain is a hologram, interpreting a holographic universe."

Within the context of the emerging holographic paradigm, Project HOT will teach African American students to think more dialectically.

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Wisdom demands a new orientation
of science and technology toward
the organic, the gentle,
the non violent,
and beautiful.

Fritjof Capra
*The Turning Point:*
*Science, Society*
*and the Rising Culture*

# Knowledge as Design: A 21st Century Tool for Learning HOT

Position paper

by

J. E. Fluellen

A Project Hot Publication

c/o 1989

**Knowledge as design:**
**A 21st Century tool**
**for learning HOT**

**by J. E. Fluellen**

What Lauren Resnick missed in *Education and Learning to Think* is worth noting. But, first, what she said makes her monograph a landmark work in the field of teaching higher order thinking.

She defines higher order thinking (HOT); describes its historical context; summarizes cognitive research, programs of development, and assessment efforts; and links teaching effectiveness to intrinsic motivation.

DEFINITION AND CONTEXT

Resnick suggests several defining characteristics of higher order thinking. These in turn set up her discussion of the historical context for teaching HOT in an information society just eleven years short of a new millenium.

To her, a higher cognitive process characteristically

- is nonalgorithmic
- yields multiple solutions
- involves nuanced judgment and interpretation
- applies multiple criteria that sometimes conflict
- requires self regulation
- imposes meaning i.e. makes order from chaos
- demands effort

Teaching these HOT skills is not new, however. The elite schools representing the **high literacy** strand in the history of education have been developing for decades. In contrast, mass education represents the **low literacy** strand. It did not aim to have its students interpret unfamiliar text, create material others would want to read, construct convincing arguments, design original solutions to technical or social problems. (Resnick, 1987)

Put simply, the problem is this: the creation and distribution of knowledge drives an information society and demands ample numbers of highly literate workers. (Hawken, 1982; Naisbitt, 1982; Kirsch, 1987). But the supply of people who have literacy and numeracy, who can use multiple sources of information to create knowledge or solve complex problems, has failed to keep up with this demand. (Office of Technological Assessment, 1982; Naisbitt and Aberdine, 1986; Resnick, 1987)

The nation's economic future depends on greater numbers of highly literate workers to fill knowledge based jobs. In Resnick's words, the idea becomes an emerging value.

> It is new to take seriously the aspiration of making thinking and problem solving a regular part of a school program for all of the population, even minorities, even non-English speakers, even the poor. It is a new challenge to develop education programs that assume that all individuals, not just an elite, can become competent thinkers. (Resnick, 1987)

**What had been kept for the elite must now be taught to all.**

## COGNITIVE RESEARCH AND PROGRAMS

Support for teaching all to think more critically and creatively comes from the cognitive research community. According to Resnick, the research not only says yes people can be taught to think but higher order processes are inseparable from what it means to learn well. Also based on anecdotal and empirical evidence many programs deliver what they promise. (Resnick, 1987)

For example, the Feurestein Instrumental Enrichment (FIE) program meets its aim of developing intelligence across ability levels, races, socioeconomic status and ethnic origins. Savell's synthesis of 35 empirical studies of FIE backs up that claim. (Savell, 1986)

## ASSESSMENT AND MOTIVATION

Finally, after summarizing the literature on cognitive research in reading and mathematics, current programs and discussing three ideas about the place for teaching thinking in the curriculum, Resnick examines assessment and motivation.

Though the New Jersey Test of Reasoning Skills, MAP (the public school district of Pittsburgh's test) and forthcoming revisions in the SAT and ACT indicate a positive trend toward standard measures of higher order processes, for the most part, standards tests fail to measure critical and creative thinking ability.

Also, no program can work without attention to development of intrinsic motivation. Teachers must model the joy of creative and critical thinking and spread this joy among their students. (Resnick, 1987)

In conclusion, what Resnick offers readers is a holistic view of teaching higher order thinking. While her presentation is far greater than the sum of its parts, some points can be abstracted.

- •Teaching HOT requires understanding its defining characteristics, historical context, research base, programs, assessment problems, and links with intrinsic motivation.
- •In practice, teaching HOT should be embedded in the curriculum, used with the enabling skills (the three Rs), and taught as a fourth R--reasoning, 1987)

Future teachers who want a tight, well written nutshell of the state-of-the-art in teaching higher order thinking will return to her monograph. What she missed, however, is also noteworthy.

BASSECHES, CAPRA, PERKINS

First, while Resnick suggests several defining characteristics, she ignores one of the few operational definitions of higher order thinking, namely Michael Basseches' **dialectical thinking**.

From a neo Piagetian, life span view of cognitive development, dialectical thinking is a meta systemic level beyond formal operations and seems to be the only description of higher order thinking that has been operationalized to date. It also extends Piagetian theory and provides an optimal goal for instruction.

Dialectical thinking combines the logical deductive reasoning power of formal operations with creative insight power. In Basseches' view, dialectical thinking combines critical and creative thinking and is, thus, a higher level of cognitive processes that some adults achieve. (Basseches, 1984)

Second, the key driver of change represented in Resnick's discussion of the historical context of teaching higher order thinking across ability levels is nothing less than a shift in world view. Teaching HOT to all children is not just an economic need for the nation's future. It is not just a new value that research in the cognitive science community supports. Teaching HOT to all is made possible by the emerging 21st century paradigm already shaping how people perceive the world and already replacing the Newtonian world view that governed the last 300 years of Western culture.

This paradigm shift has been well documented in the 1980s. (Bohm, 1987; Campbell, 1982; Capra, 1982; Glick, 1987; Hawken, 1983; Naisbitt, 1982; Naisbitt and Aberdine, 1985; Prigogine, 1984; Rifkin, 1980; Russell, 1983; Toffler, 1980; Wilber, 1989; World Future Society, 1989)

Moreso, the changing of the guard--what Alvin Toffler calls a shift from second wave industrial culture to third wave information culture--has several key drivers including these:

- •exponential growth of ecological problems that transcend national borders (Brown, 1988 and 1989; World Future Society, 1989)
- •development of an international interest in space colonization (World Future Society, 1989)
- •convergence of computers, television, and fiber optics into a information network for a global, knowledge based economy (Brand, 1987)

•creation of a holographic paradigm to join science and spirit (Wilber, 1989)

**Key drivers of change shape historical context and suggest and new world view.**

Most articulate among those writing about this once in an age time when the value and belief system of an entire civilization is in direct conflict with a newborn replacement has been Fritjof Capra, a theoretical physicist turned philosopher and popular culture writer. Says Capra, a paradigm shift is "a profound change in the thoughts, perceptions, and values that form a particular vision of reality." (Capra, 1982)

Such a profound change began with the bellweather sciences and spread to psychology. It is documented in physics on the one hand with three major 20th century theories, namely Einstein's theory of relativity, quantum mechanics, and, more recently, the theory of chaos. On the other hand Piaget's theory of cognitive development and Pribram's holographic theory of cognitive processes illustrate the shift from behaviorism to cognitivism in psychology. Finally, David Bohm and F. David Peat have been developing a theory of order that transcends fields. (Bohm and Peat, 1987) It, too, expresses a world view in sharp contrast to a Newtonian/Cartesian order of time and space.

An understanding of why and how educational reforms are sweeping nations across the globe can only be seized with an understanding of historical context--an information society with an emerging, 21st century world view and its key drivers of changes.

Again Capra: "The universe is no longer seen as a machine, made up of a multitude of objects, but has to be pictured as one indivisible, dynamic whole whose parts are essentially interrelated and can be understood only as patterns of a cosmic process."

Finally, Capra sends home the theme of his extended essay, *The Turning Point: Science, Society and the Rising Culture* in these words: "in contrast to the mechanistic Cartesian view of the world, the world view emerging from modern physics can be characterized by words like organic, holistic, and ecological." (Capra, 1982)

**The emerging 21st century world view and its corresponding key drivers are roots of the shift of global economy and new discoveries in cognitive science research. They make up the historical context for teaching HOT to all children, in all districts, in all parts of the world.**

Resnick ends her summation of programs by suggesting that philosophy and cognitive science combine efforts.

> We need, then, substantial new research, requiring the collaboration of philosophers and cognitive scientists, to identify approaches to teaching reasoning that actually improve reasoning performance either in academic disciplines or in practical situations. (Resnick, 1987)

A short plane ride from the University of Pittsburgh where Resnick works to Harvard University where Perkins works, an even quicker electronic message or fiber optic carried phone call to Perkins would have connected her to a HOT program that combines insights from epistemology and cognitive science.

D. N. Perkins, Director of Harvard University's Project Zero, invented **knowledge as design** to give teachers a means of teaching critical and creative thinking across the curriculum, ability levels, ages, socioeconomic status and ethnic origins.

The gist of Perkins' system is this: any structure adapted to a purpose has four generic features. That means a rock, inherently, would not have a purpose, structure, model cases or arguments. But a screwdriver would. So would a text book, math formula or play. That means Einstein's theory of relativity can be reasoned about in terms of what it does, how it is made, what it can be compared with and how it functions in physics. That means any subject matter teacher could teach a concept or skill in terms of its purpose, structure, model cases and arguments--explanatory, evaluative and deep explanatory. (Perkins, 1986)

Such a system of invariants gives an infinite number of ways to teach lessons, design materials for directed reading and thinking activities, or invent research and development programs. Most of all, this system gives students a flexible strategy for putting ideas into long term memory--the right stuff for reasoning, writing, and reading. The substantial new research Resnick calls for on an approach such as knowledge as design is likely to be produced in the 1990's because the method is a relatively recent innovation.

In conclusion, Lauren Resnick continues to make major contributions to the field of higher order thinking as Editor of *Cognition and Instruction*. Her landmark monograph, however, could be revised to include Michael Basseches' dialectical thinking, the full historical context for teaching HOT, and Perkins' knowledge as design.

More importantly, though, any teacher interested in a transdisciplinary system of higher order thinking should invest $20 dollars and a lot of time in Perkins' *Knowledge as design*. His system develops critical and creative thinking in learners from 5 to 95 years old.

It fits the holographic paradigm, blends epistemology with cognitive science and, best of all, makes the teacher a knowledge creator.

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